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A Hierarchical Logit Model**

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## Choice of a Retail Store and Retail Store Format: A hierarchical logit model

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### Abstract

*The literature on store choice has mainly studied the store attributes, and ignored the consumer attributes in store choice. Even when, the consumer attributes have been incorporated the strength of relationship has been weak. Also, the literature on store choice has completely ignored format choice, when studying store choice.*

*The paper argues for incorporating both the shopper attributes in store choice, and the store formats. Shopper attributes can be captured through the demographic variables, as they can be objectively measured, and these also capture a considerable amount of attitudinal and behavioural variables. The paper proposes to link store choice, format choice and consumer demographic variables, through a hierarchical logistic choice model in which the consumers first choose a store format and then a particular store within that format.*

*A nested logit model is developed, and the variables predicting the choice probabilities are identified. The requirement of data for the empirical analysis is specified, the model has not been verified in the absence of empirical data but the operationalization of variables is done.*

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## **Introduction**

Lately, retail has been one of the growth areas in the global economy. It has witnessed a high growth rate in the developed countries and is poised for an exponential growth, in the emerging economies. Along with the rapid growth, retailing scenario has also been characterized by increasing competition and emergence of increasingly new retailing formats (Popkowski Leszczyc, Sinha, and Timmermans, 2000). With an overlap of merchandise being offered across different formats, the competition has become intense and unpredictable in terms of the direction where it is coming from. In the light of these, the study of how consumers choose retail stores, and what drives the store choice, cannot be overemphasized. The emergence of a variety of retail formats, offering a diverse mix of offerings to the consumers, adds further confusion to the domain of store choice. One way to look at the problem of store choice is then to acknowledge the emergence of various store formats and incorporate them into the models for store choice.

## **Outline**

The objective of the paper is to integrate store choice and format choice in a single framework. We first do an extensive literature of the store choice and the format choice, literature and identify gaps. We then propose an integrated model of store and format choice to address the issue of format and store choices.

## **Literature Survey – Store Choice**

Store choice has been a subject of wide research and has been studied from various perspectives. The store choice behaviour of shoppers has been found to be quite similar to the brand choice behaviour of the consumers, with a difference being the incorporation of the spatial dimension in store choice (Sinha and Banerjee, 2004). Therefore, while brand choice is independent of the location aspect, and is not affected by it, the store choice is very much influenced by location (Fotheringham, 1988; Meyer and Eagle, 1982). One view, in the store choice literature gives primacy to the store location and believes that the consumers are influenced by the travel costs of shopping (Brown 1989; Craig, Ghosh, and McLafferty 1984; Huff 1964) and store location therefore plays an important role in the store choice. A number of studies, have considered, and pointed out the primacy of store location (Arnold, Oum and Tigert, 1983; Freymann, 2002) in store choice.

Another view in store choice literature focuses on the store attributes. Price is one of the easily noticeable attributes and considerable work exists (Bell, Ho and Tang, 2001; Freyemann, 2002; Arnold, Oum and Tigert, 1983), on how, the price of store offerings, affects the store choice. The role of store atmospherics, store ambience and store environment has also been studied as a part of store attributes. A number of studies (Kotler, 1973; Baker, Grewal and Levy, 1992) have studied these and found important relation with consumer store choice. Then there are studies which look at how store environment cues influence consumers' store choice decision criteria, such as perceived merchandise value and shopping experience (Baker, Parasuraman, Grewal, and Voss, 2002). Store choice, has also been studied, taking the store image (Martineau, 1958) into account and has been found to affect store choice.

Yet another view of store choice, gives more importance to the consumer side, and has looked at the consumer attributes, as well as the situational and tasks associated with shopping. So the store choice has been seen in the context of the risk reduction strategies of the shoppers (Mitchel and McGoldrick, 1996; Mitchell and Harris, 2005). In addition work on store choice has also been done on the role of situational factors (Wu, Petroschius, and Newell, 2004; Mattson, 1982) and the task-store attribute relationship (Kenhove, Wule, and Waterschoot, 1999). It has also been found to be dependent on the timing of shopping trips, with consumers visiting smaller local store for short “fill-in” trips and larger store for regular shopping trips (Kahn and Schmittlein, 1989). It has also been shown by Bell and Lattin (1998) that there exists a logical relationship between a household's shopping behavior and store preference. A narrower segment of the store choice research has been devoted to studying individual difference variables, such as demographic, socio-economic, or psychological variables, as the key predictors of store choice (Bellenger, Robertson and Hirschman 1976; Douglas, 1976; Monroe and Gultinan, 1975; Winn and Childers, 1976). One drawback of the research in this field has been that though the studies identified relationships, the strength of relationship with the store choice was found to be weak (Mattson, 1982).

### **Literature Survey – Format Choice**

The literature on format choice is limited in nature and is of more recent origin. The recent interest in store formats is mainly attributed to innovations in the mix that the

retailers are coming up with, owing to the competition. A store format has been defined as the mix of variables that retailers use to develop their business strategies and constitute the mix as assortment, price, and transactional convenience and experience (Messinger and Narsimhan, 1997). It has also been defined as a type of retail mix used by a set of retailers (Levy and Weitz, 2002). Different store formats are derived from various combinations of price and service output (Solgaard and Hansen, 2003).

The format literature can be traced back to the discussion on cross shopping, which was first discussed in the trade literature in the late 1970s (Cort and Dominguez, 1977). This is recognised now as the “incidence of consumers shopping at different types of retailer formats for products also commonly referred to intra-type competition (i.e. two different retail formats that sell substitutable products or services)” (Carpenter and Moore, 2006, p4). It has evolved further with studies based on grocery as well as other sectors and has dealt with issues dealing with, within chain choice (Cort and Dominguez, 1977), within product sector choice (Cassill and Williamson, 1994), choices based upon marketing and store attributes (Gehrt and Yan, 2004; Hansen and Deutscher, 1977) and multi-channel choices (Schoenbachler and Gordon, 2002). With the new formats being introduced in the evolving markets, the retail offering of these store formats in the evolving markets has also been studied across different product categories (Sinha and Banerjee, 2004).

The choice of retail formats is richer in studies with consumer attributes as explanatory variables, and a lot of work has specially been devoted to the consumer demographics. The study of Crask and Reynolds (1978) dealt with frequent and non-frequent shoppers to the departmental stores, and found frequent patrons tended to be younger, more educated, and had higher incomes. In another study, Sampson and Tigert (1992) found that warehouse club members were more upscale as compared to the general population, were more educated and had higher incomes. Similarly, Arnold (1997) found significant differences between the demographic profiles (e.g. age, education, household size) of large-format department store shoppers and non-shoppers. Similarly, the work of Carpenter and Moore (2006) found that certain demographic groups were associated with certain store formats. In addition their study also examined store attributes (e.g. price competitiveness, product selection, and atmosphere) as drivers of format choice. Bhatnagar and Ratchford (2004) developed a general model of retail format choice for non durables, and they demonstrated that the retail format choice depended on a number

of factors such as travel costs, consumption rates, perishability of products, inventory holding costs of consumers etc.

Studies have also been conducted on shopper behaviour and format choice. In a study of store choice behaviour among audio equipment shoppers, Dash et al. (1976) found shoppers having higher levels of pre-purchase information shopped at specialty store, while those with low pre-purchase information purchased at departmental stores. In another study, Bell and Lattin (1998) demonstrated that large basket shoppers preferred EDLP formats, while, small basket shoppers, preferred HiLo stores, similar results were arrived at by Bell, Ho and Tang (2001).

### **Summary of the literature**

A review of the literature on store choice and format choice reveal the following:

- The research in store choice literature has a beginning far earlier, than format choice literature.
- The literature in store choice had more width as well as depth, as compared to the store choice literature.
- The literature looks at both as separately, and few overlapping studies, which incorporate store as well as format choice are available.
- The store choice literature, is heavily loaded towards studies examining, store choice based on store attributes. Even where, the consumer attributes (demographics etc.) have been used, the relationship is weak. In format choice, the stress is more on consumer attributes (mainly demographic), leading to particular types of formats.
- The store choice literature, has studied, stores within the same format, and fails to identify that competition exists across formats. In addition, store attributes, identified in the literature are not unique to the store, but are rather shared by a number of stores operating within the same format (and some even across formats).

### **The question of shopper attributes in store choice**

That the store choice, can be completely captured based only on store attributes, and ignoring the shopper attributes especially when there is considerable consumer diversity, seems to be preposterous. The store choice will be governed both by the store attributes as

well as the consumer attributes. Looking at the store attributes in isolation is like looking at the supply side (what the store offers), and not on the demand side (what the shopper is looking for). To capture store choice, it is essential that, both the store attributes as well as the shopper attributes are captured. The problem comes from the fact that in the existing studies on store choice, the relationship between, store choice and the shopper attributes are very weak. This could be a consequence of, low store loyalty and significant store switching which is significant for grocery store purchases (Kau and Ehrenberg, 1984; Uncles and Hammond, 1995; Popkowski Leszczyc and Timmermans, 1997}. It is fairly, well established in the literature that store switching, is quite widespread and unstable even in short term. Actually it has been seen that many consumers regularly visit two or more stores simply because they undertake shopping trips from different places as home, office etc (Solgaard and Hansen, 2003), different preferences for stores, based on the composition of the basket of goods, to profit from the lowest prices at the various stores or by engaging in multistop, multipurpose trip behaviour (Popkowski Leszczyc and Timmermans, 1997). Another reason why the relations are weak might be, that these did not take into account the store formats.

One way of overcoming, these problems, is in integrating store choice, format choice, and the consumer attributes within the same framework. In the literature pertaining to store choice the consumers evaluate a group of stores on a set of attributes and then, depending upon their individual preferences, patronize the best store. It has generally been seen that all the stores in the choice set are in the same formats (Bhatnagar and Ratchford, 2004). This indicates that the first choice for the shopper is that of the format and store is the subsequent choice. An analysis of the store switching behaviour by (Galata, et.al, 1999), revealed modest levels of inter-format switching, but a large extent of intra-format switching, their study further found that when shoppers switch they choose a store of the same format. This again indicates that, the choice is at two levels, the format and then the store. Accordingly, we model, store choice as a hierarchical choice, with shoppers first choosing a store format, which is based on the demographic variables and other socio-economic factors. The demographic variables, are stable within a short range, and the literature on the format choice (Galata, Randolph, Bucklin, and Hanssens, 1999) has also assumed, the format choice to be relatively stable in short term. Therefore, incorporating the format choice, through the stable demographic variables, it is possible, to model store by incorporating consumer variables at a higher level and store attributes at a lower level.

## **Contribution**

This paper attempts to make a number of contributions to the marketing research. First, it models store choice as a hierarchical process in which depending on their demographic attributes (are stable in nature), and their present needs (dynamic), the consumers first choose a store format, and then move on to choose a particular store within the chosen store format. It also tries to plug the gap in the literature on store choice, which has looked at either the store attributes or the consumer attributes in isolation. Thirdly, it identifies that the format choice, and store choice are dependent on different customer attributes, and models them differently. Lastly, format choice and store choice has been seen independently, as Bell, Ho and Tang (1988) pointed out, the retail site selection models do not capture the effect of retail pricing format on store choice. This study attempts to combine both of them in the same framework and to plug this gap.

## **Model**

We use a nested logit formulation and model consumers' store choice decisions to be a two-stage process in which consumers first choose the store format and then the store from which to buy groceries. We use the shopper attributes along with the store/format attributes to model the choice. The importance of the shopper attributes is emphasized because, Bell and Lattin (1998), demonstrated a systematic relationship between a household's shopping behavior and store preference. At the same time it has also been shown that store choice and shopping trip timing decisions (or the shopping behaviour) tend to be different for individuals and households as a consequence of personal differences, household composition, and activity patterns (Popkowski Leszczyc and Timmermans, 1997; Kim and Park, 1997).

## **Demographic variables, Shopper attributes and Store choice**

Having emphasized the need for capturing the shopper attributes in the store choice model, we choose only the demographic and socio-economic variables, for modeling. The reasons are that first and foremost, most of the existing studies have already used such information and the utility of using demographic variables as predictors for format choice has already been demonstrated. Secondly, the demographic details are more freely available, can be objectively measured and have a greater confidence attached to them by



managers. Lastly, even the values, attitudes and behavioral attributes to some extent can be captured by the demographic variables.

In the literature on values, a connection has been recognized between values and brand choice behavior (Erdem, Oumlil, and Tuncalp, S. 1999). It has also been reported (Rokeach, 1973) that different brands of detergents and cars may appeal to consumers who hold different values. Subsequently, Keng (1993) who examined the relationship between value choice and demographics, was able to demonstrate that, consumers choosing different personal values differed in their demographic make up. Similarly, attitude toward a store is seen as a function of the consumer's perceptions or beliefs, of store attributes and the demographic, socioeconomic and personality characteristics. Also the household characteristics of the consumer as size, number and age of children also influence the attitude formation process (Solgaard and Hansen, 2003).

### **Classification of store formats**

The literature on format choice differentiates across various store formats, such as convenience stores, supermarkets, supercenters and mass merchandisers. The convenience stores have the lowest breadth of assortment, but the highest price, while supermarkets have higher breadth as compared to convenience stores but lower prices (Bhatnagar and Ratchford, 2004) Super centers are differentiated from the traditional supermarkets, as they have the offer items at lower prices and offer one-stop shopping (Carpenter and Moore, 2006). Mass merchandisers while offering, the lowest-prices also offer a one-stop convenience (Fox, Montgomery, and Lodish, 2004), however they are generally located in out of town locations, and the distances to be traveled are therefore larger. The classification in the literature is not very rigid, for example Messinger and Narasimhan (1997) demonstrated, that supermarkets owe their success to one-stop shopping, it seems the terms have been used loosely. However, for the purpose of the study, we conceptualize, the differences, as the width and depth of assortment, in creasing from convenience to mass merchandisers and the prices decreasing again from the convenience store to the mass merchandiser, i.e. as we move from a convenience store to a mass merchandiser, we encounter lower prices, and wider and deeper assortments. Another way these will be different is that we observe a pyramidal structure in the number of store of each format. Because of the cost structure and the target population needed to sustain each of the store formats (large population for mass merchandisers, and

small one for convenience stores), they will vary in number, and accordingly will their average distance for any customer.

Other formats that exist are, category killers and specialty grocers, offering product assortment differentiation and customer relationship management (Hansen and Solgaard, 2004). In the pricing formats of EDLP and HiLo, besides the pricing strategies, the EDLP stores typically offer lower levels of service than the HILO stores do (Lal and Rao, 1997). All the customers naturally, do not prefer a cheaper store or the one-stop convenience. A cheaper store might be offering lower levels of service, poor presentation, poor atmospherics (Bhatnagar and Ratchford, 2004), and even crowding, which might reduce the benefits drawn and increase the costs. Similarly, all the customers might not need a wide assortment, and indulge in multi-store shopping, because of category dependence, narrow range in the shopping basket, low opportunity cost of time. Hence, we say that in a heterogeneous base, different shoppers will choose different store formats depending on their own characteristics, and the values being offered by the formats.

### **Factors affecting Format choice**

The different demographic and socio economic factors can affect the format choice and the store choice in two different ways. One is that these factors directly affect the format and the store choice. The other way is that, these affect the shopping basket, and the timing of the shopping trip, and therefore indirectly affect the format choice.

#### ***Family size and composition***

Family size and composition implies the total number of members in a family and the distribution between adults and children. Larger families will have higher levels of consumption and will buy larger quantities of products/services to satisfy the consumption. They will also require a wider variety of products, and therefore are likely to get stocked out more frequently than smaller families (Bawa and Ghosh, 1999). It is thus likely that larger families will have larger basket sizes and larger number of shopping trips. The existing research supports that household size has a positive effect on the likelihood of a shopping trip (Popkowski Leszczyc, Sinha, and Timmermans, 2000). Similarly Bawa and Ghosh, (1999), found that the size of the family was positively associated with the frequency of shopping trips and the basket size.

The household composition, will also affect the shopping basket, it has been suggested that for a given household size, the presence of children in the household is likely to lower expenditures relative to an all-adult household due to differences in consumption rates for children and adults (Prais and Houthakker, 1971; Benus, Kmenta and Shapiro, 1976; McClements, 1977; Muelbauer, 1980). In addition, the presence of children is likely to result in a more diverse basket size, with higher chances of stock outs and greater impulse purchases. Thus the presence of children will induce baskets, with larger baskets in terms of categories, but smaller baskets in terms of size.

In a comparison of convenience stores, and the supercenters, (Carpenter and Moore, 2006) demonstrated that, smaller households tend to patronize traditional neighbourhood markets rather than travelling to larger grocery shopping venues such as supercenters. In the light of all the above it is proposed that, the family size should be positively related to a patronage of supercenters (and away from convenience stores). This will happen on account of both a larger basket size and a more diverse basket composition (Bhatnagar and Ratchford, 2004). In addition, as the larger basket size is associated with EDLP formats, the family size should be positively related to shopping in EDLP formats.

#### ***Income level of the family***

High family income levels, may lead to higher consumption levels, which would imply larger aggregate shopping. Previous research (Prais and Houthakker 1971; Houthakker and Taylor 1970) supports the view that a household's income has a major effect on its consumption. In addition the higher income will result in a shopping basket comprising of goods of better quality (Bawa and Ghosh, 1999) and is also expected to have a wider variety of assortment in the consumption. Thus the aggregate shopping is expected to grow with the income levels and also diversify in terms of the objects of consumption. With a higher income level, the impulse shopping will be less drain on the resources and is also expected to increase.

In addition high-income households will have a higher opportunity cost for time and should be less willing to spend time on shopping trips for utilitarian consumption. Thus the frequency of shopping trips is expected to be negatively related to household income (Bawa and Ghosh, 1999). Bawa and Ghosh, (1999) found that higher income households tend to shop more frequently, similar result was also found by Popkowski Leszczyc and

Timmermans (1997). Also as the opportunity cost rises, the shopping trips might become, multi-purpose shopping trips and the shopper might prefer a one-stop convenience.

Thus, higher incomes should be positively related to a patronage of supercenters (and away from convenience stores). The larger income will give rise to differentiated assortments and will therefore be associated with speciality stores. In addition, higher incomes, might create the need for higher service; since HiLo stores are associated with higher service (Lal and Rao, 1997), higher incomes might be associated with shopping in HiLo stores. (Galata et. al., 1999), have also obtained results, which point to relation between choosing HiLo stores and higher income levels.

#### ***Employment status of the family members***

The number of working members in the family is expected to relate to the income of the family, the consumption levels and thus the size of the basket. The increase in the number of working adults will increase consumption in two ways. Firstly it will have a positive effect on the income and the consumption; secondly it might result in higher demand for services and products as a result of the time constraint of the adults and the opportunity cost of time.

For the families with higher number of adult members working, the opportunity cost of time is high, and tends to reduce the frequency of shopping trips and at the same time increase the basket size. Bawa & Ghosh, (1999) and Popkowski Leszczyc & Timmermans (1997), support that households having working adults have a lower frequency of shopping trips as compared to households in which adults are not working. It also found that households with two working adults shopped less than households with one working adult.

A higher number of working members in the family, would imply a higher opportunity cost, and result in lesser number of shopping trips and bigger basket sizes. Also, this might lead to multi-purpose shopping trips and shoppers might rather prefer, a one-stop shop than visiting a number of shops. Therefore, the number of working members would be positively related to patronage of supercenters (and away from convenience stores).

**Factors affecting store choice**

Store choice has been seen to be affected by a number of store variables, to various degrees. Of these some might be similar within formats (and hence captured in format choice), and some might be different across stores within the same format. Here we discuss the factors, which might be different across stores within the same format.

***Distance***

Store location, and the role of distance to a store to the store choice have been fairly well studied. A number of studies, have pointed out that, consumers are influenced by the travel costs of shopping (Brown 1989; Craig, Ghosh, and McLaffarty 1984; Huff 1964) and store location therefore plays an important role in the store choice. A number of studies, have considered, and pointed out the primacy of store location (Arnold, Oum and Tigert, 1983; Freymann, 2002) in store choice.

However, studies have also found that distance might not always be the major factor. (Galata et. al, 1999), found that for a particular segment of consumers, the most preferred store (an EDLP store) was on an average, the farthest away. The 'cost' incurred on distance might be actually, offset by values received such as store experience, better layout etc., however there is a fair degree of unanimity on distance affecting the store choice and hence we use distance as a predictor of store choice.

***Vehicle Ownership***

A vehicle ownership might moderate the effects of distance, as without a car the perceived marginal costs of shopping at a store farther away, might exceed the perceived benefits (Bell, Ho, and Tang, 1998). Hence we use vehicle ownership as another factor affecting store choice.

***Promotions***

Store promotions have been a widely studied area in the literature, notably Guadagni and Little, (1983) and Gupta (1988). In terms of store choice behaviour, studies on single category studies by Kumar and Leone (1988) and again by Bucklin and Lattin (1992) show mixed results, for the effect of category level marketing activity on consumers' store choice decisions. While, Volle (2001), investigated, the short-term effect of store-level promotions on grocery store choice, though results were significant but weak.

However, it has generally been accepted that, retailers often use promotions involving price discounts to increase store traffic and stimulate purchase (Grewal et. al. 1998). Walters (1991), found that the promotions of products in one store significantly reduced the sales of substitutes and complements in a competing store. Even though the evidence is mixed, we use the store level promotion as to affecting store choice.

### ***Store loyalty***

The inherent loyalty to the store has also been investigated for the ongoing store choice. Volle (2001), demonstrated that, store choice is mainly driven by loyalty. Inherent loyalty will breed inertia, and a 'stickiness' with the store for the shopper. If the shoppers have been patronizing a store for a long period of time, they do not mind buying from a store located at a greater distance (Sinha and Banerjee, 2004). Similarly (Bell, Ho, and Tang, 1998) have argued that households might develop a category specific store loyalty due to repeated buying from the same store. They have said that this actually habitual behavior may provide some implicit value to the shopper. (Park, Iyer and Smith, 1989), also found that store knowledge, (gained from past visits) does affect, the failure to make purchases, especially under time constraints. On the same line (Bell, Ho, and Tang, 1998) believe that the search cost of an item is affected by the store loyalty. However, store loyalty might also be moderated by certain demographic variables. It has also been found that store loyalty is cultivated when the female and the male are working (Popkowski Leszczyc and Timmermans, 1997), as a high opportunity cost for time will force the shoppers to economize on their search costs and breed store loyalty. Also, it has also been observed that high-income households are more likely to display a store switching behaviour (Popkowski Leszczyc and Timmermans, 1997). In view of all this, we take existing loyalty as one of the predictors of store choice.

### **Logit Models**

Logit formulation and especially Multinomial Logit Framework has been quite popular in marketing literature. Even for Household store choice, the probabilities have been modeled within the MNL framework in a number of studies on store choice (Arnold, Oum and Tigert, 1983; Bucklin and Lattin, 1992; Grover and Srinivasan, 1992).

Nested logit (NL) models have been used to analyze travel and transportation modes (Hensher, 1991; Sobel, 1990), welfare effects of changes in environmental quality

(Morey, Rowe, and Watson, 1993), migration models (Falaris, 1987) and also in the valuation of environmental amenities (Kling and Thomson, 1996).

An assumption of both the multinomial and the conditional logit models is that the choices are independent of one another. The Independence from Irrelevant Alternatives (IIA) derives from the assumption that the stochastic disturbance terms are independent and identically distributed. The IIA assumption will not hold if the stores within same format are perceived as close substitutes. The NL model was developed to deal with the restrictive assumption of independence between all the alternatives. The nested logit helps in maintaining the IIA selectively i.e. within nests (Greene, 1997). Thus the IIA assumption is maintained through modeling the close substitutability between nested (grouped) alternatives through correlation on utility components. It therefore allows for differential substitution patterns within and between nests (groups).

Nested logit, though not as common as MNL, has also been used to model store choice behaviour. Fotheringham (1988), described its use in modeling store choice as a hierarchical choice. Bucklin and Lattin (1992), modeled brand purchase within store purchase using nested logit. Sinha (2000), applied nested logit to, model store choice, as a two stage process in which consumers choose a suburb, where to shop and then the store from which to buy groceries.

### **Nested Logit Models**

As already discussed, Nested logit models are a generalization of the multinomial logit model. In a two level nesting structure, suppose there are  $j = 1, 2, \dots, J$  alternatives. Now, if these  $J$  alternatives can be partitioned into  $K$  groups say  $G_k$   $k = 1, 2, \dots, K$ .

If  $y \in \{1, 2, \dots, J\}$  is the indicator for the realized outcome, and  $j$  is an element of group  $G_k$ , then the probability of  $y = j$  can be decomposed into

$$P(y = j) = P(y \in G_k) \cdot P(y = j \mid y \in G_k)$$

### **Model Formulation**

The utility derived by the  $i^{\text{th}}$  family for the  $j^{\text{th}}$  store in the  $t^{\text{th}}$  time is given as:

$$\begin{aligned} U_{ijt} &= \delta(D_{ij}) + \zeta\beta(V_{ijt}) + \theta(P_{ijt}) + \lambda(L_{ijt}) + \varepsilon_{ijt} \\ &= V_{ijt} + \varepsilon_{ijt} \end{aligned}$$

D: is distance of the store  
 V: ownership of vehicle  
 P: Price Promotion by store  
 L : Loyalty to the store

$i = 1; \dots; I$  families,

$j = 1; \dots; J$  stores,

$t = 1; \dots; T$  time periods,

$V_{ijt}$  is the deterministic component of utility, adjusted for a given store format

$\varepsilon_{ijt}$  has a Gumble distribution.

For the format choice, utility derived by the  $i^{\text{th}}$  family for the  $k^{\text{th}}$  format is as given by

$$\begin{aligned} U_{ikt} &= \alpha(\text{FS}_{ik}) + \beta(I_{ikt}) + \gamma(\text{HOE}_{ikt}) + \varepsilon_{ikt} \\ &= W_{ikt} + \varepsilon_{ikt} \end{aligned}$$

FS: is Family size (assumed constant during the period)

I: Income level (assumed constant during the week)

HOE: Hours of employment

$i = 1; \dots; I$  families,

$k = 1; \dots; k$  formats,

$t = 1; \dots; T$  time periods,

$W_{ikt}$  is the deterministic component of utility

$\varepsilon_{ikt}$  has a Gumble distribution.

Based on the assumption that, both the error terms  $\varepsilon_{ijt}$  and  $\varepsilon_{ikt}$  have a Gumble distribution the probability that the  $j^{\text{th}}$  store will be chosen by the  $i^{\text{th}}$  family in the  $t^{\text{th}}$  time period given that the  $k^{\text{th}}$  store format was chosen, is

$$P(d_{ijt} = 1 | k) = [\exp.V_{ij}] / [\sum_{j \in F(k)} \exp.V_{ij}]$$

Where  $F(k)$  is the set of stores in format  $K$ .



And the probability that the  $k^{\text{th}}$  format is chosen is

$$P(d_{ikt} = 1) = [\exp.W_{ik}] / [\sum_k \exp W_{ik}]$$

$d_{ijt}$  = 1, if family  $i$  chooses the  $j^{\text{th}}$  store in the  $t^{\text{th}}$  time period,  
= 0, else

$d_{ikt}$  = 1, if family  $i$  chooses the  $k^{\text{th}}$  format in the  $t^{\text{th}}$  time period,  
= 0, else

### Data and Operationalization of variables

To calibrate and test the model, panel data is required. The normal panel is captured at the point of sale in a particular store. However for the purpose of this study, a panel data, is needed in which the panelists use scanners/diaries in their homes to record purchases at all retail formats and outlets, such data now seems to be available and similar data generated by IRI has been used in studies (Fox, Montgomery, and Lodish, 2004). Such data for a period of one year might be needed.

Since such data is captured at the households, who might be paid for this. The demographic and socio-economic details might be easily available. Thus the family size, Income level and hours of employment can be captured. In short run (say one year), these variables, might also be stable, and the time aspect of the model can be actually ignored for these variables.

- Thus the family size is operationalized, as the family members permanently staying together. A mean of the family (starting and ending), might be needed in case of births and deaths.
- Income of the family is operationalized as combined weekly income of all the working family members.
- Hours of employment is operationalized as hours worked per week, by all the working family members (Popkowskieesczyc, Sinha, and Timmermans, 2000).
- The distance to the store, might be measured, by measuring the centroid distance across the zip codes of the household and the store.
- Vehicle ownership can again be taken from the families, and might be measured as a dichotomous variable, as to whether the family owns a car or not.
- Price promotion by store needs to be operationalized at store level, and these are done as the proportion of all purchases at a store chain that are made on promoted

items, weighted according to the household's average market basket (Fox, Montgomery, and Lodish, 2004).

- The variable loyalty is operationalized as the exponentially weighted average of past incidences of store choice, treated as 0-1 variable (Guadagni and Little, 1983).
- It has been seen that, different formats are clearly differentiated. However, the terms have been loosely used in the literature (super-markets and super centers), the same needs to be corrected. This can be done, by forming a panel of experts who are familiar with the stores, who classify the stores, in different formats, the conflicts might be resolved by majority/discussion/decision of the researcher.

### **Extension of work and future areas**

Once the data is available, the empirical verification of the model can be done. Additional variables, like the age and gender of the person doing the actual shopping on each of the shopping trips might capture more of the actual variances. The family composition though discussed has been ignored, in the model formulation the same can also be done.

The present study, models the hierarchical choice as nested logit, however logit formulations are more applicable to stable situations. The format choice is more stable in nature, as compared to the store choice; therefore a better model could be by combining in a two-stage model a multinomial logit framework for format choice and a hazard model for the store choice.

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